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Evaluation of corporate initiatives in ergonomics: Effectiveness of ergonomics training in an oil and gas refinery company

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Abstract. *Corporate initiatives in ergonomics refer to the initiatives taken by corporation to introduce and implement ergonomics program. It is highly desirable in order to achieve optimum performance of productivity and a quality of working life, especially in the increasing competitive global market where the survival of a corporation depends on how it responds to a highly dynamic and complex environment. Somehow, implementing corporate initiatives in ergonomics will not be easy. Therefore, the objective of this paper is to examine the correlation between corporate initiatives towards ergonomics and ergonomics training effectiveness. A Sociotechnical System (STS) as an open system approach on how to design work and its environment which integrates engineering and social science is used to conduct this study. Four elements of STS components: the technological subsystem, the personnel subsystem, the relevant environments and organizational structure is studied by quantitative and qualitative methods. The finding of this study shows that the top management initiated an ergonomics program due to strong request from employees. An external consultant was hired to solve ergonomics problem raised by the workers and train members on ergonomics. The ergonomics training program was found to be an important and effective approach in introducing ergonomics. Somehow, in order to ensure that ergonomics have great impact on the overall company's performance, ergonomics training need to be designed and tailored according to the target audiences and needs.*

Keywords: *Corporate initiatives, Socio-technical system, Macroergonomics, Ergonomics training.*

1. INTRODUCTION

Ergonomics is concerned with developing knowledge about human capabilities, limitation and other characteristics related to the design of the interfaces between human and other system components which are beneficial in an effort to improve human well-being and overall system performance (Davis, 1982). Many corporations have reported significant benefits today as a result of successful ergonomics program implementation (Butler, 2003; Joseph, 2003; Moreau, 2003; Morag, 2007). Therefore, corporate initiatives in ergonomics are highly desirable in order to achieve optimum performance. Somehow, implementing corporate initiatives in ergonomics is not an easy task. There are several elements that need to be considered in order to ensure that the ergonomics program is successful. Workstation design, organizational design, quality aspect, participative aspect and training are among basic elements in examining corporate ergonomics initiatives (Hagg, 2003). This paper seeks to explore ergonomics training as an important element in corporate ergonomics initiatives towards enhancing quality of life and company's performance.

1.1 Corporate Initiatives in Ergonomics

Corporate initiatives are seen as a strategy plus align with management necessity to achieve high level of success. It can be imposed either externally by regulations of a government agency or internally by policies handed down by senior management (Wade & Recardo, 2001). In addition, these initiatives crucially have a great impact on a company's performance.

Corporate initiatives in ergonomics refer to the initiatives taken by corporation to introduce and implement ergonomics program. As stated by Wade and Recardo (2001), these initiatives are imposed by external and internal factor referring to regulations by government and policies by top management (Kearney, 1995 and Butler,2003). Other than regulations and policies, costs are one of the factors in adopting ergonomics program. Halpern and Dawson (1997) asserted the impact of increasing worker's compensation claim, and this is further supported by Lewis et al (2002) in terms of costs due to incidence of musculoskeletal disorders (MSDS).

Other than external factors, internal factors and

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costs, improvement factors must be put into consideration to adopt ergonomics program effectively. The first factor focuses on the need to improve productivity and quality of products (Attaran and Wargo, 1999). This will lead to demand for better company image (Hagg, 2003). Secondly, the need to improve workers' quality of life (Fernandez, 1995 and O'Neill, 2005). All these factors must be integrated with initiatives which may come from the management (Laitinen et al., 1998), Department of Ergonomics or Safety & Health (Joseph, 2003), external consultants (Broberg and Hermund, 2004) and trade unions (Laitinen et al., 1998).

The management of a corporation always need to consider workers well being in order to sustain the productivity and quality of products.

1.2 Ergonomics Training

Ergonomics program would not be successful without management commitment in providing an adequate ergonomics training. The management commitments towards ergonomics training can be discerned by allocating sufficient budget and hiring an external consultant to bring expertise on ergonomics.

Ergonomics training is essential to educate all level of employees. Good ergonomics training will help increase employees' awareness on ergonomics and equip them with knowledge and skills to identify ergonomics risks and hazardous and fix the ergonomics problem (Johnson, 1998). Adequate training on new machines or equipments installed or new working procedures introduced are also needed to help the employees performing their tasks properly.

In order to improve productivity and OSH, Shikdar and Sawaqed (2003) suggested that employees need to be trained systematically in ergonomics. Joseph (2003) argues that ergonomics can be implemented with workers and management problem solving teams if they are trained properly and given appropriate plant support. For success in ergonomics work, Munck-Ulfsfalt *et al.* (2003) recommended that it should start with training and information on the entire management group and explaining the employer's responsibility accordingly. They also suggest that the instructor must have a comprehensive view of ergonomic affair, as well as both a comprehensive view and in-depth knowledge of the product, process, production and personnel.

Effective ergonomics training can lead to substantial benefits for both corporation and employees in terms of increase productivity, improve product quality, reduce absenteeism and turnover rates, as well as lower operational cost (Joyce, 2003).

1.3 Sociotechnical System Theory

Sociotechnical Systems (STS) which is largely associated with organization development methods generally attempts to develop a better 'fit' between technology, structure and social interaction of a particular process or production unit. It has been widely use in the implementation of ergonomics (Hagg, 2003; French and Bell, 1978; Bill, 1986; Carayon and Smith, 2000).

STS integrates technology and humans and is aimed at a planned change of organizational work design for the purpose of enhancing and improving organizational efficiency through the alteration of organizational members' on-the-job behaviors (Garviel and Karwoski, 1994). Performance improvement is a key reason for implementing STS. Similarly, it is aligned with ergonomics aims (Oborne, 1982). Therefore, in order to measure the effectiveness of ergonomics program in a corporate setting, the STS approach is used. In simple terms, it is a systematic approach to diagnose which enables a company to implement improvements in a consistent way.

When a new way of work is to be implemented, there are several problems to consider. Tichy (1983) divides the problems into three types: technical problems that concern internal and external efficiency, political problems that concern the distribution of power and resources, and cultural problems that concern change and development of organizational cultures.

Consistent with STS theory, macroergonomics asserts the organization as comprising of: (1) technological subsystem, (2) personnel subsystem, (3) environmental subsystem, and (4) organizational and managerial subsystem (see Figure 1).

The technological subsystem holds the component of workstation design, tools and equipment, product design and employees' knowledge and skills. This subsystem affects organizational behavior whereas the personnel subsystem plays the roles of recruitment, training, participation and feedback mechanism. These two subsystems go simultaneously by joint optimization. Therefore, organizational and managerial subsystem play a larger role in making these two subsystems working effectively (Hendrick, 2007). Somehow, the environmental subsystem brings organizations to view their environments as sources of inspiration or provocation (Pasmore, 1988).

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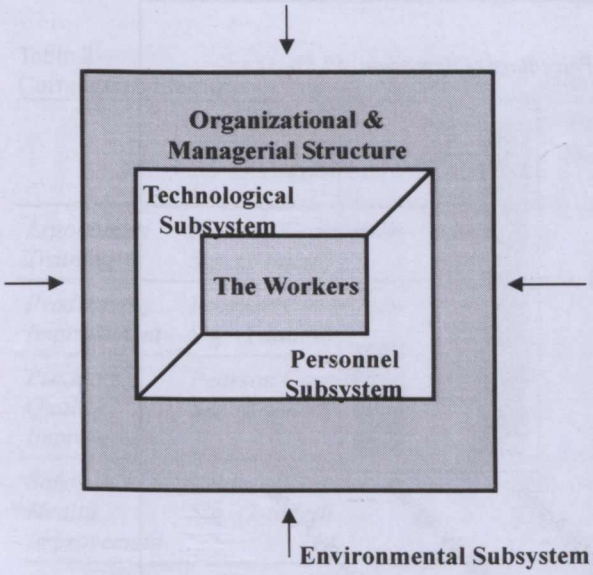

Figure 1: Theoretical Model

Since STS theory regard technology and humans as important elements in enhancing organization's efficiency and performance, the role of ergonomics training is crucial to ensure joint optimization between both technological and personnel subsystem. In the meantime, organizational and managerial subsystem plays a role in supporting ergonomics training. The environmental subsystem may act as a catalyst to trigger management in providing ongoing ergonomics program.

2. METHODS

This study was conducted with the objectives to examine the correlation between corporate initiatives and ergonomics training and its effectiveness. A STS as an open system approach on how to design work and its environment which integrates engineering and social science is used to conduct this study. Four elements of STS components: the technological subsystem, the personnel subsystem, the relevant environments and organizational structure were studied by quantitative and qualitative methods.

2.1 Questionnaires

A questionnaire was used in this study to obtain information from the respondents. The questionnaire consist of a set of Likert-type scales multiple-choice items. Basically, the questionnaire was designed in four sequential sections covering:

(1) General background data, i.e. gender, age, education level, years of employment, position in the organization, designation and department.
(2) Factors driving the adoption of ergonomics program.
(3) The respondents' perception towards the company current status due to ergonomics initiatives.
(4) The respondents' agreement on the company practices related to ergonomics initiatives.

The survey (N = 27) was conducted during February – May 2009 in a local oil and gas refinery company. The result was used to describe the respondents' reaction on the above issues.

2.2 Interviews

Semi-structured interviews were conducted with organization key persons such as representative from top management, safety and health officer, human resource department, production and union focusing on why ergonomics is needed, how ergonomics is implemented, aspects of cooperation between the whole organization and what is the outcome of ergonomics implementation from each representative point of view. An interview guide is used and the interviews are recorded.

2.3 Documentation

Company documents related to ergonomics training were collected and analyzed. These include training attendance records and training materials.

3. RESULTS

3.1 The Milestone of Ergonomics Program Adoption

Interview with key persons revealed that the management introduced the ergonomics program due to demand from employees. This agrees with result of the survey which showed that 59.3% of the respondent agreed that the management initiated the ergonomics program due to the demand from union representatives (see Fig. 2).

3.2 Management Commitment towards Ergonomics Training

Full and complete management support is a crucial element in the success of initiating an ergonomics program (Morag, 2007).

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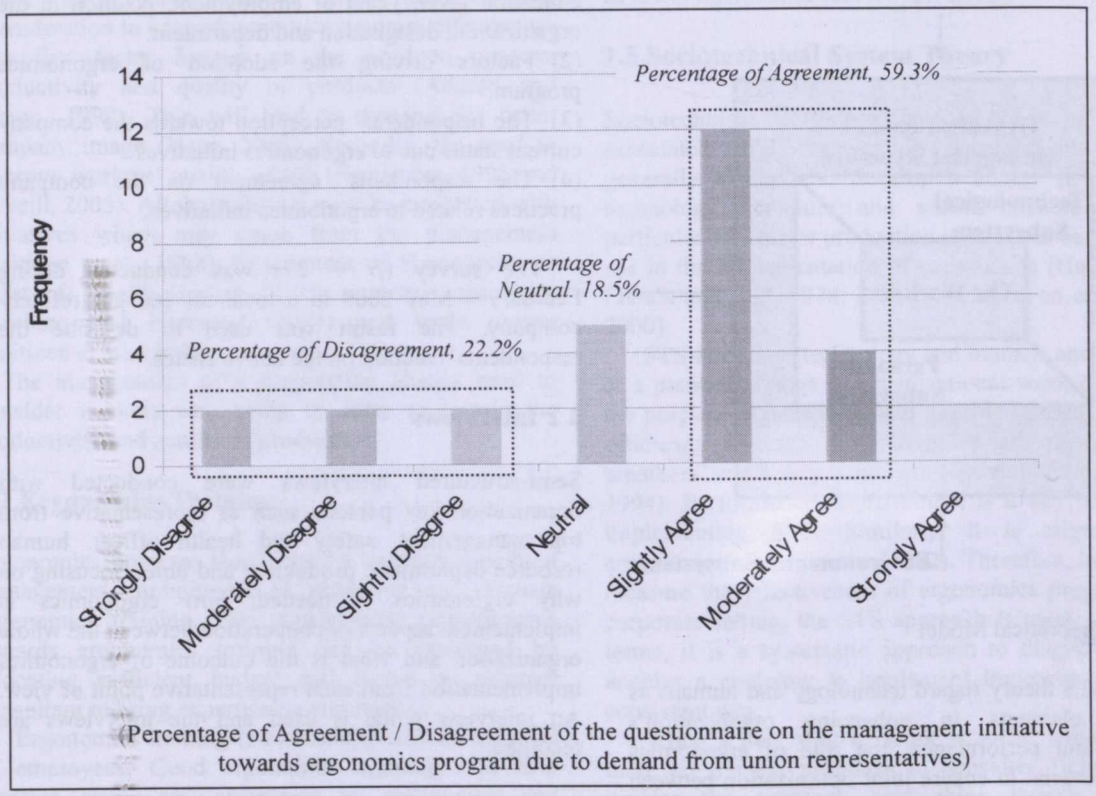

Figure 2
Frequencies of agreement of union representatives' demand for ergonomics improvement

Table 1
Correlations elements of Ergonomics Training and Management Commitment

		Company Policy	*Financial Allocation*	*External Consultant*	*Reward System*	*Ergonomics Training*
Company Policy	*Pearson Correlation*	*1*	*.434**	*.522***	*0.544***	*.257*
	Sig. (2-tailed)	.	*.024*	*.005*	*.003*	*.205*
Financial Allocation	*Pearson Correlation*	*.404**	*1*	*.739***	*.792***	*.900***
	Sig. (2-tailed)	*.037*	.	*.000*	*.000*	*.000*
External Consultant	*Pearson Correlation*	*.522***	*.714***	*1*	*.696***	*.684***
	Sig. (2-tailed)	*.005*	*.000*	.	*.000*	*.000*
Reward System	*Pearson Correlation*	*.544***	*.815***	*.696***	*1*	*.757***
	Sig. (2-tailed)	*.003*	*.000*	*.000*	.	*.000*
Ergonomics Training	*Pearson Correlation*	*.257*	*.839***	*.684***	*.757***	*1*
	Sig. (2-tailed)	*.205*	*.000*	*.000*	*.000*	.

There is a significant correlations between ergonomics training and management support, (r=.839, p=.000, p<0.01); external consultant, (r=.684, p=.000, p<0.01); reward system, (r=.757, p=.000, p<0.01) as shown in table above.

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Table 2
Correlations Elements of Ergonomics Training & Performance

		Ergonomics Training	*Productivity Improvement*	*Products Quality Improvement*	*Safety & Health Improvement*	*Cost Reduction*	*Decrease Absenteeism*
Ergonomics Training	*Pearson Correlation*	*1*	*.487**	*.435**	*.385*	*.603***	*.683***
	Sig. (2-tailed)	.	*.012*	*.026*	*.052*	*.001*	*.000*
Productivity Improvement	*Pearson Correlation*	*.487**	*1*	*.815***	*.555***	*.236*	*.381**
	Sig. (2-tailed)	*.012*	.	*.000*	*.003*	*.230*	*.050*
Products Quality Improvement	*Pearson Correlation*	*.435**	*.815***	*1*	*.349*	*.126*	*.290*
	Sig. (2-tailed)	*.026*	*.000*	.	*.074*	*.530*	*.142*
Safety & Health Improvement	*Pearson Correlation*	*.385*	*.555***	*.349*	*1*	*.293*	*.369*
	Sig. (2-tailed)	*.052*	*.003*	*.074*	.	*.138*	*.058*
Cost Reduction	*Pearson Correlation*	*.603***	*.236*	*.126*	*.293*	*1*	*.871***
	Sig. (2-tailed)	*.001*	*.230*	*.530*	*.138*	.	*.000*
Decrease Absenteeism	*Pearson Correlation*	*.683***	*.381**	*.290*	*.369*	*.871***	*1*
	Sig. (2-tailed)	*.000*	*.050*	*.142*	*.058*	*.000*	.

There is a significant correlations between ergonomics training and productivity improvement, (r=.487, p=.012, p<0.05); products quality improvement, (r=.435, p=.026, p<0.05); cost reduction, (r=.603, p=.001, p<0.01); decrease absenteeism, (r=.683, p=.000, p<0.01).

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In order to identify management commitment towards ergonomics training, a few elements were measured. Management commitment elements consist of (1) company policy (2) management support (3) external consultant and (4) reward system.

Table 1 showed correlation between ergonomics training and management commitment. The result indicated that there was significant correlation between ergonomics training and most of the management commitment elements. Management support shows correlation coefficient of r = .839, external consultant (r = .684), and reward system (r = .757). Somehow, there was no significant correlation between ergonomics training and company policy (r = .257)

3.3 Ergonomics Training Effectiveness

Ergonomics training seeks to create awareness and provide employees with the knowledge and relevant skills in order to perform their task and identify ergonomics hazard (Johnson, 1998 and Morag, 2007). The effectiveness of ergonomics training would reflect the organizational performance and the enhancement of employees' quality of working life. Organizational performance can be evaluated based on; (1) productivity improvement (2) product quality improvement and (3) cost reduction. Employees' quality of working life can be assessed by; (1) safety and health improvement (2) decrease in absenteeism and (3) Job satisfaction.

Table 2 shows the correlation between ergonomics training and performance. The result indicated that there was significant correlation between ergonomics training with most of the performance measurement elements. Productivity improvement shows a correlation coefficient of r = .487, product quality improvement, r = .435, cost reduction, r = .603, and decrease in absenteeism, r = .693. Somehow, there was no significant correlation between ergonomics training and safety and health improvement, r = .385.

4. DISCUSSION

There are a few ways for a corporation to introduce an ergonomics program. Essentially, 'top-down' or 'bottom-up' approaches are commonly used to initiate an ergonomics program. In the top-down approach the initiative is from the top management. In the 'bottom-up' approach employees participate in identifying ergonomics risks and problems and generate ideas on how to fix it. Both approaches have advantages and disadvantages. The application will depend on the corporation's political, socioeconomic and cultural factors. Thus, there is no right or wrong answer on which approach is to be recommended.

4.1 The Adoption of Ergonomics Program

The adoption of ergonomics program can be imposed by external and internal factors (Kearney, 1995 and Butler, 2003). External factors include government regulations or pressure to reduce operation cost due to market competition (Kearney, 1995 and Butler, 2003). Internal factors refers to internal demand for ergonomics which might be due to incident of musculoskeletal disorders (MSDS), worker's discomfort due to improper workstation design or the need to improve productivity and product quality (Lewis et al, 2002, Attaran and Wargo, 1999).

In this study, the demand from union representatives was found to be the only factor for the top management to initiate the ergonomics program. This is a result of the interview carried out with the Health, Safety and Environment Department manager and Training Department manager. This is supported by the survey which showed that 59.3% of the respondent agreed that the management initiated the ergonomics program due to the demand from union representatives. Moreover, the union representatives revealed that initial requests to improve the workstation design originated from the employees working in the control room. The control room operators complained that they were experiencing back pain and discomfort due to prolonged sitting. In an oil and gas refinery, closed monitoring with minimum human error at the control room is very crucial to ensure the whole plant runs smoothly and safely. The management had responded to the request by hiring an external consultant to diagnose and solve the problem. This finding demonstrates that the combination of both 'top-down' and 'bottom-up' approach have been successfully applied.

4.2 Management Commitment towards Ergonomics Training

Ergonomics program would not be successful without the management commitment (Faville, 1996). Ergonomics training is the most important and powerful approach to equip workers with knowledge and skills. Thus, management commitment towards ergonomics training is crucial to ensure the success of an ergonomics program. The result of the study indicated a positive significant correlation between ergonomics training and management commitment in the form of financial allocation, hiring external consultant and the setting up of a reward system. Somehow, there was no

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significant correlation found between ergonomics training and company policy (Table 1).

The management has given full support to the ergonomics initiative by allocating sufficient budget for ergonomics program. According to the Training Department manager, the top management allocated RM 200, 0000.00 (approximately USD 60 thousand) per year for training purposes including ergonomics training. The first ergonomics training was conducted by an external consultant with the aim to overcome problem raised by workers in the control room. The external consultants found that the workers were experiencing discomfort due to long hours of sitting on unergonomically designed chair. Therefore the training was focused on the proper practice of sitting posture. They also recommended to the top management to change the existing chair to ergonomically designed chair. These efforts and intervention has brought a positive impact on workers' morale in performing their task (Fernandez, 1995). Clearly, the management decision to hire external consultants has contributed significantly to the ergonomics training and ergonomics initiatives. This is reflected by the finding where a positive significant correlation was found between ergonomics training and external consultant, r = .696.

In order to encourage employees to participate in the ergonomics program, the top management had introduced the "My Act" scheme. Monetary reward is given to those who give good ideas on how to improve the workstation design including the work process design. Some of the ideas were used as input into the ergonomics training need assessment. Based on the findings, there was a positive significant correlation between ergonomics training and reward system, r = .757.

Ergonomics literatures have tended to emphasize on the need for top management to establish company policy on ergonomics as part of the corporate strategy. Shikdar and Sawaqed (2003) suggested that strategies should be formulated and implemented in order to systematically introduce ergonomics in industry. Joseph (2003) argues that it is much easier to get the management and employees to understand, realize, accept and become involved in ergonomics programs if it is link with the company's operation strategy. Therefore ergonomics programs should not be regarded as separate from those intended to address other workplace hazards but it must be a part of company safety and health policy. Somehow, in this study, company policy and ergonomics training was found to be not significant due to the absence of company policy on ergonomics. One explanation for this finding is that ergonomics is new to the company. The management still is still unaware of the great beneficial effects that can be gained by implementing an ergonomics program. Further, ergonomics was not clearly stated in the Occupational Safety and Health Act of 1994 (OSHA 1994). The national regulation emphasizes on the employer to protect workers wellbeing, to protect others and creating a conducive environment (Muhammad and Taha, 2008).

4.3 Ergonomics Training Effectiveness

Ergonomics training do not apply the concept of 'one size fit for all'. The contents and length of the training should vary according to the target population and their needs (Morag, 2007). It is not only the employees that have to be trained with knowledge of ergonomics, but also the managers. Ergonomics training should equip managers with ergonomics assessment knowledge to ensure employees' well being (Joyce, 2003). Therefore, the managers should know what the workers are dealing with in their daily routine job. This also helps the managers to make decision on proper training selection. The results show that the same training materials have been used for managers and employees for the internal ergonomics training program.

In the company, ergonomics knowledge only focuses on basic ergonomics issues such as sitting, lifting and hazard awareness. This has narrowed down the perception of the role of ergonomics in the company's performance as well as workers' quality of working life. Ergonomics actually covers most of the issues related with human factors. The correlation between factors of safety and health improvement and ergonomics training was found to be not significant (r = .385). This is due to the misconception and lack of knowledge in ergonomics.

4.4 Good Ergonomics Good Economic

In the sense of ergonomics are still seen timid in the company, it has indirectly contributed to beneficial effects on organization overall performance. These effects shown in term of productivity improvement (r = .487), product quality improvement (r = .435), cost reduction (r = .603) and significant decrease in absenteeism (r = .683).

Productivity improvement is a major concern with corporate managers. Improving productivity means reducing the total operational cost which lead to increase competitiveness. Consistently, ergonomics should be considered as a tool to enhance overall productivity through workplace improvement (Helander and Burri, 1995).

Ergonomics and product quality are both important aspects and closely related. The need to improve product quality is one of the main focuses in

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corporate performance improvement. There are many literatures addressing the positive relationship between the success ergonomics implementation and product quality improvement (Rowan and Wright, 1995, Gonzalez et al., 2003, Kleiner, 2006). Reducing ergonomic risk jobs has been correlated with a subsequent increase in product quality (Joseph, 2003).

Other than productivity and products quality improvement, ergonomics also can be linked to intangible improvement such as operator comfort, convenience and jobs satisfaction (Helander and Burri, 1995). All of these factors help in decreasing workers' absenteeism as well as increase their morale.

Ergonomics training may be one way of highlighting issues related to productivity, poor products quality as well as high absenteeism (Joyce, 2003). Therefore, even the effort taken was a baby step, but it has brought out a great impact on the overall performance.

5. CONCLUSIONS

Management commitment in the form of financial allocation, hiring external consultant and setting up reward system are crucial in ensuring the successfulness of ergonomics training. Ergonomics training need to be designed and tailored according to the target audiences and needs. In this study, ergonomics training were found to be an important and effective approach in introducing ergonomics.

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